# The NASA "Why?" Files The Case of the Barking Dogs

# Segment 2

The tree house detectives continue their investigation into what is causing the dogs to bark. They decide to use the neighborhood map to analyze and record responses from the neighbors. The next step in their investigation is to brainstorm about what sounds make dogs bark and then visit an audiologist to learn more about human ears. Next, they visit a NASA psychoacoustician to find out about the psychological effects of noise on human beings (noise pollution). The children wonder whether noise pollution from high-frequency sounds is causing the dogs to bark. The Methods of Science play a role in keeping the kids focused on the problem, and they decide to do more research by visiting their local veterinarian to see if they are still on target with the original hypothesis. The doctor explains the difference between human hearing and dog hearing and guides the children into considering high-frequency noises as a possible cause of the dogs' barking. The detectives visit the anechoic chamber at NASA to learn more about how sound travels. With the help of Dr. D., the children learn about frequency and how it affects wavelength. The children think they have narrowed down the probable cause of the barking dogs...but have they really?

### **Objectives**

The students will

- · learn map skills by using a local map.
- learn to use pictograph representations with pushpins of various colors.
- learn about noise pollution and how noise frequency affects humans and animals.
- determine the range of frequencies for human hearing by learning more about the human ear.
- determine the range of frequencies for dog hearing by learning more about the dog ear.
- discover similarities and differences between the dog ear and the human ear by using a Venn Diagram.
- discover how sound becomes softer as it travels away from the source.
- discern different sounds by a sound egg activity.
- learn how frequency affects wavelength with the use of pan pipes and squawkers.
- learn, through research, how animals are adapted for hearing.
- measure length using the metric system.

### Vocabulary

absorb - to take in and not reflect

anechoic chamber - a special chamber that absorbs sound

audiologist - a person who helps others with hearing difficulties

consumer - a person who uses goods for his own needs

**echo** - the repetition of a sound by reflection of the sound waves from a surface

**high frequency** - a greater number of sound waves passing a particular point in one second. Frequency is measured in Hertz (abbreviated Hz)

**matrix** - a set of numbers or terms arranged in rows and columns used to sort and organize data for interpretation

pattern - an arrangement of shapes or colors in an order

**pest zapper** - an electronic device that emits high-frequency sounds at a frequency level that deters insects from a given area

**pollution** - the contamination of the soil, water, or air with substances that don't belong

**psychoacoustician** - a person who investigates the psychological effects of noise on human beings

**resonance** - a condition in which the frequency of an external force matches with the natural frequency of an object

**sonic** - having to do with the speed of sound (738 mph at sea level)

veterinarian - an animal doctor

# Video Component (15 min)

#### Before Viewing

- 1. Briefly summarize the events in segment I with the students.
- 2. Ask the students to hypothesize the cause of the barking dogs.
- 3. Review the Methods of Science. You may wish to choose an activity from segment I that you have not performed and use it as a review for the scientific method.
- 4. Introduce the vocabulary. Have students write a definition for audiologist, psychoacoustician, and veterinarian and share their responses.
- 5. Ask the students to predict what will happen in segment 2.

#### View the Video

View segment 2 of the video. Discuss the questions that are asked at the end of the second segment.

- Will the tree house detectives solve the case?
- Do you think their hypothesis is right or wrong?
- Are high- and low-frequency important in solving this problem?

#### After Viewing the Video

- 1. Continue to guide students in modifying and adding to the Methods of Science Board created in segment I, (p.14).
- 2. Choose from the activities in this packet (p. 30-37) to help reinforce the concepts and objectives being emphasized in segment 2.

#### Careers

**Audiologist** Psychoacoustician Veterinarian **Animal Trainer** Ears, Nose, and Throat Doctor (ENT)

### Resources

#### Web Sites

#### Noise & Noise Control

Explores how to measure noise and explains what levels of noise pollution are dangerous. http://www.tir.com/~ms/noisecontrol/noisecontrol.html

The Noise Center has links for noise facts, hearing hazards, airport noise, journal articles, and a children's section. http://www.lhh.org/noise/index.htm

#### Diagram of Human Ear

http://www.audiologyawareness.com/hhelp/anat100.gif

#### **Hearing Information**

How we hear, hearing tests, types of hearing loss and hearing loss to newborns and infants are some of the topics explored. http://www.audiologyawareness.com/hhelp/lib.htm

#### **Exploration of Sound**

The Soundry site teaches you about the ear, the physics of sound, and the how sound is used in today's world. <a href="http://library.thinkquest.org/19537">http://library.thinkquest.org/19537</a>

#### Books and References:

Martin, Michael C. and Summers, Ian R., Editors: *Dictionary of Hearing*. Whurr Pub Ltd, September 1999, ISBN 1861561326

Charles, Veronika Martenova: *Hey, What's That Sound?* Stoddart Kids, December 1996, ISBN 0773757023

Gibson, Gary: *Hearing Sounds (Science for Fun*). Copper Beech Books, September 1995, ISBN 156294323

Baker, Alan: *I Thought I Heard (Noises)*. Copper Beech Books, April 1996, ISBN 0761304606

Van Cleave, Janice: *Physics for Every Kid.* John Wiley & Sons, March 1991, ISBN 0471525057

Pfeffer, Wendy: *Sound All Around*. HarperCollins Juvenile Books, January 1999, ISBN 0060277114

## **Activities and Worksheets**

### In the Guide | Neighborhood Pictograph Activity ...30 A cooperative group activity in which students create a neighborhood map and make a pictograph. Diagram of Human Ear ......32 A worksheet that diagrams the human ear. Diagram of Dog Ear ......33 A handout that shows a diagram of a dog ear. Venn Diagram ......34 A worksheet to use for comparing and contrasting the human ear with the dog ear. "Sounds Like" Activity ......35 Students have the opportunity to "tune-up" their hearing by guessing what is creating the sound produced in a plastic egg. A scavenger hunt helps reinforce the metric system for measurement of length. Inverse Relationships ......37 A worksheet to help students understand inverse relationships.

Teacher Answer Key ......38

On the Web You can find the following activities on the Web at http://whyfiles.larc.nasa.gov.

#### Play Those Pipes Again Sam

Make your own pan pipes to give students an experience with varying frequencies.

#### Squawker

Give students the opportunity to explore pitch by varying the length of a straw.

#### **Animal Adaptation for Hearing**

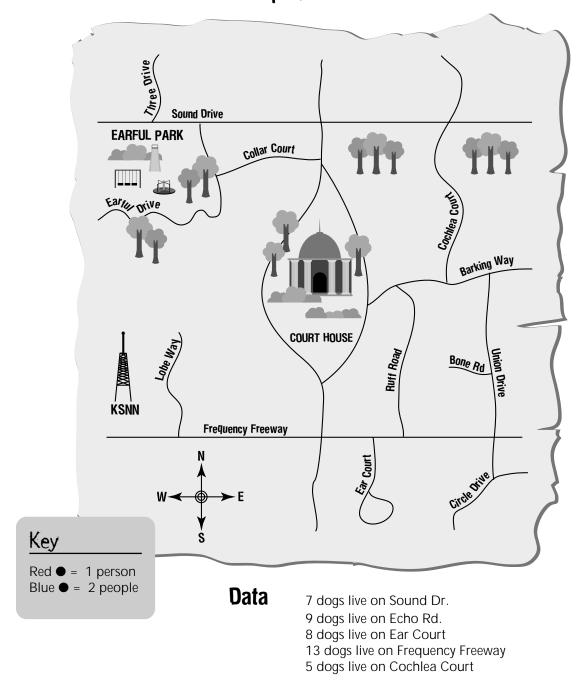
A handout and research guide for students to explore how animals' hearing adapts to their environment.

# Neighborhood Pictograph Activity

**Purpose** To give students an opportunity to explore maps and pictographs.

Use color coding to represent the number of dogs on each street. Draw the appropriate number and color of dots on each street. For example: 3 dogs will equal one red dot and one blue dot.

# Map of Echo Holler



# Neighborhood Pictograph Activity

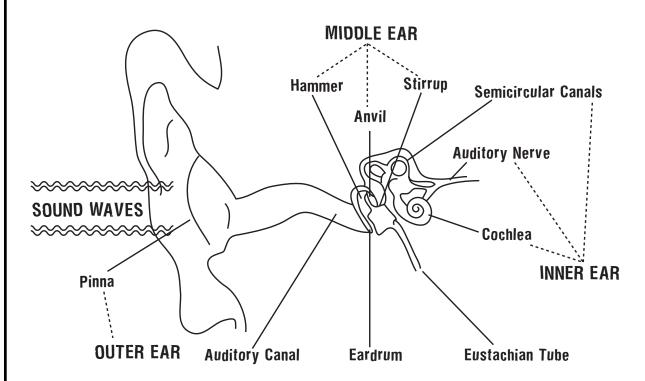
Create a pictograph. Choose a symbol to represent 10 people who heard loud sounds and draw the appropriate number and type of symbol in the space provided:

	# of People who	
	Heard Loud Sounds	Pictograph
Noisy Nook	25	
Seaside Sound	50	
Hollow Sound	77	
Echo Holler	105	
Auditory Lane	57	
Impulse Road	35	
Canal Street	48	
<b>Reverberation Ro</b>	w 90	

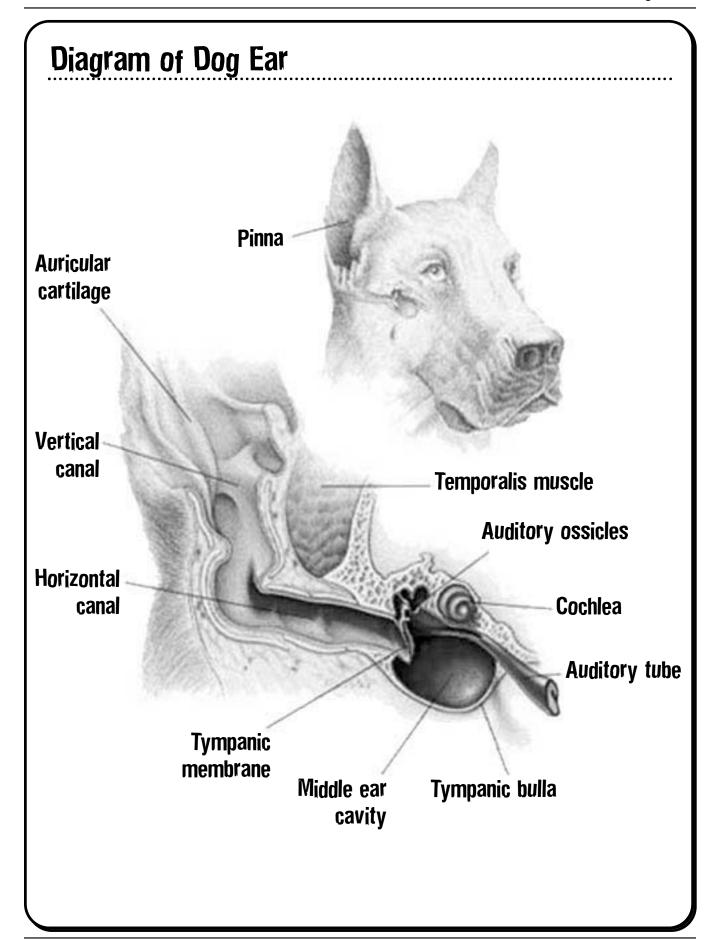
Key: = 10 symbol

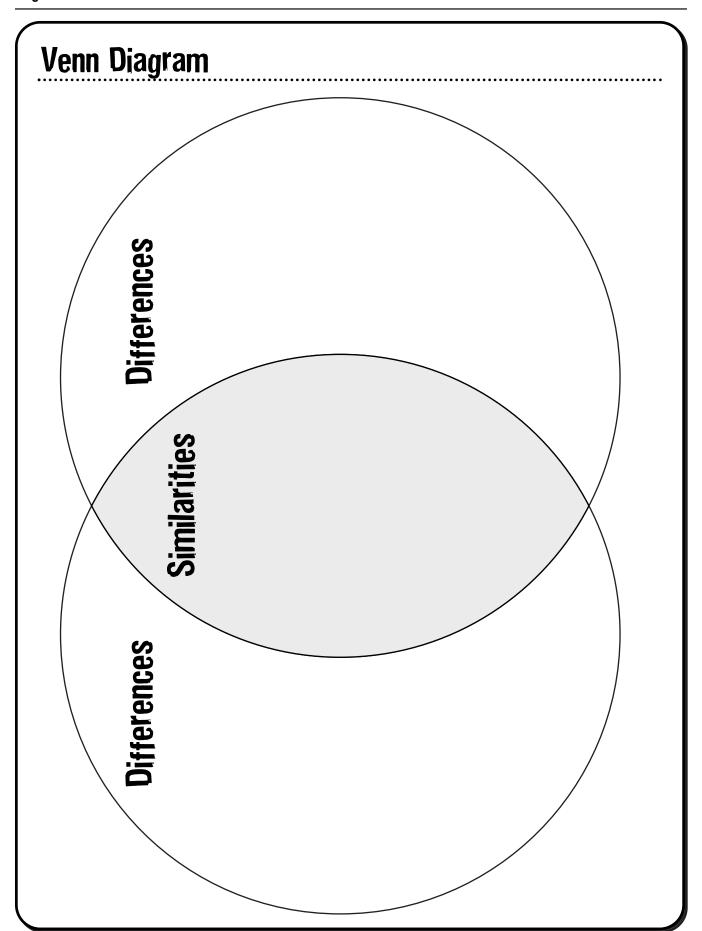
# Diagram of Human Ear

The outer ear collects and concentrates sound energy, which is then channeled down the ear canal. The eardrum vibrates, along with the small bones within the ear. The sound then goes through the cochlea, the hair cells bend, and the impulses are sent up the auditory nerve to the brain where they are decoded.



Label the following parts of the ear: 1. Connects ears with the throat. 2. Snail shaped part of the inner ear. 3. Part of the ear on the outside of the head. 4. First part of the ear to vibrate. 5. Middle bone of the ear. The higher the sound, the more rapidly your eardrum vibrates. The lower the sound, the slower your eardrum vibrates. Give two examples of sounds that will make your eardrum vibrate very quickly and two examples of sounds that will make it vibrate more slowly. Sounds that make your eardrum vibrate very quickly: 6. \_\_\_\_\_ Sounds that make your eardrum vibrate more slowly:





# "Sounds Like" Activity

#### **Purpose**

To give students the opportunity to "tune-up" their hearing by guessing what is creating the sound produced in a plastic egg.

- **Procedure** 1. Have one person of each pair select 5 eggs, mark each egg with the numbers 1-5, and fill each egg with a different set of objects. (The teacher may do the numbering before beginning the activity.)
  - 2. Fill each egg with a different set of objects.
  - 3. The student's partner will shake each egg, one at a time, and listen carefully to the sound to guess what is in the egg.
  - 4. Record guess on the "Sounds Like" Chart below.
  - 5. Once all eggs have been shaken and guesses have been made, the students can open their eggs and compare their guesses with the correct answers.
  - 6. Switch positions and repeat with other partner.

### Materials

5 plastic eggs numbered 1-5 for each set of partners

Small items such as rice, beans, paper clips, eraser tops, marbles, etc. Enough of each to fill the maximum number of eggs needed.

Paper/Chart Pencil

#### **SOUNDS LIKE CHART**

	Partner 1		Partner 2	
Egg #	Guess	Actual	Guess	Actual
1				
2				
3				
4				
5				

- **Conclusion** 1. How did the weight of the objects affect the sound of the object?
  - 2. Which objects were high-frequency sounds? Low-frequency sounds?
  - 3. Which object was the loudest of all? Why?

**Extension** Teacher can create a set of eggs for each group with identical objects in each. Students work in groups to discern what objects are in the eggs. The group with the most correct answers wins "Great Ears" for the day! Chart or graph class responses.

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**Purpose** 

To give the students an opportunity to estimate and measure length using the metric system.

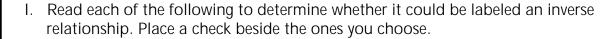
Try to Find Objects of These Lengths

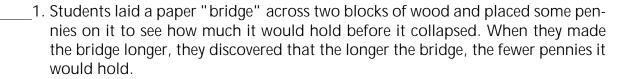
Lengths	Name of Object	Actual Measurement	Difference
1 m			
24 cm			
5 cm			
3 m			
2 1/2 m			
16 cm			
25 mm			
8 cm			
94 cm			
2 m			

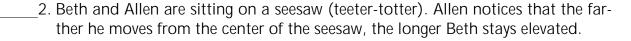
# **Inverse Relationships**

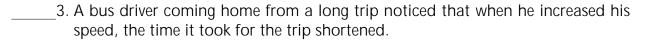
The term "inverse relationship" is used to describe a relationship between two things, wherein one of them increases while the other decreases.

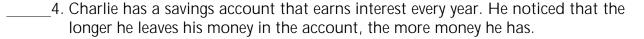
Example: The more I lick my ice cream cone, the less ice cream I have.

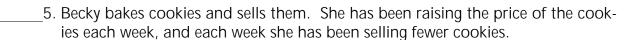


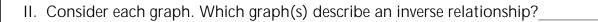


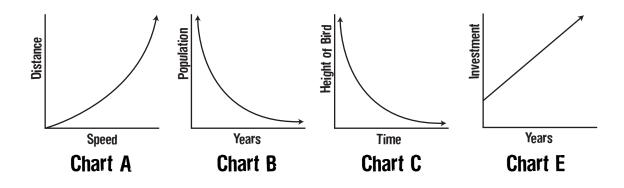












# Teacher Answer Key

### Diagram of Human Ear

- 1. eustachian tube
- 2. cochlea
- 3. pinna
- 4. eardrum
- 5. anvil
- 6-9 Answers will vary.

### Inverse Relationships

1. 1, 3, 5

II. B, C